

PATENT COOPERATION TREATY
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)
(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference CON301001P	FOR FURTHER ACTION	See Form PCT/IPEA/416			
International application No. PCT/AU2005/000986	International filing date (<i>day/month/year</i>) 4 July 2005	Priority date (<i>day/month/year</i>) 5 July 2004			
International Patent Classification (IPC) or national classification and IPC					
<table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">Int. Cl. E01C 23/09 (2006.01) B28D 1/22 (2006.01)</td> <td style="width: 33%;"> B28D 1/26 (2006.01) B28D 1/28 (2006.01) </td> <td style="width: 33%;"> E01C 23/12 (2006.01) E21C 27/14 (2006.01) </td> </tr> </table>			Int. Cl. E01C 23/09 (2006.01) B28D 1/22 (2006.01)	B28D 1/26 (2006.01) B28D 1/28 (2006.01)	E01C 23/12 (2006.01) E21C 27/14 (2006.01)
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Applicant CONCRETE SLAB TECHNOLOGY PTY LTD et al					

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☒ (*sent to the applicant and to the International Bureau*) a total of 10 sheets, as follows:

☒ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (*sent to the International Bureau only*) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:

<input checked="" type="checkbox"/>	Box No. I	Basis of the report
<input type="checkbox"/>	Box No. II	Priority
<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input type="checkbox"/>	Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input type="checkbox"/>	Box No. VI	Certain documents cited
<input type="checkbox"/>	Box No. VII	Certain defects in the international application
<input type="checkbox"/>	Box No. VIII	Certain observations on the international application

Date of submission of the demand 22 December 2005	Date of completion of this report 03 February 2006
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  DAVID LEE Telephone No. (02) 6283 2107

Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

- ☒ The international application in the language in which it was filed
- ☐ A translation of the international application into _____, which is the language of a translation furnished for the purposes of:

- ☐ international search (under Rules 12.3(a) and 23.1 (b))
- ☐ publication of the international application (under Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

☐ the international application as originally filed/furnished

☒ the description:

pages **1,5,8-16,18** as originally filed/furnished
pages **2,3,4,6,7,7A,17** received by this Authority on
22 December 2005 with the letter of 21 December 2005
pages* received by this Authority on with the letter of

☒ the claims:

pages as originally filed/furnished
pages **19-22,24-26** as amended (together with any statement) under Article 19
pages **23,27,28** received by this Authority on
22 December 2005 with the letter of 21 December 2005.
pages* received by this Authority on with the letter of

☒ the drawings:

pages **1-10** as originally filed/furnished
pages* received by this Authority on with the letter of
pages* received by this Authority on with the letter of

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to the sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to the sequence listing (*specify*):

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-66	YES
	Claims	NO
Inventive step (IS)	Claims 1-66	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-66	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

JP 2001081714, JP 08-103908, EP 294267, DE 3743643, WO 2002/002289, WO 2001/038242, DE 3837102, DE 2815744

Novelty & Inventive step - Claims 1 - 66

The citations disclose apparatus for applying a force to a groove for the purpose of creating a crack along the groove. Further discloses is the use of an external elongate member (in JP 08-103908) to assist crack propagation.

None of the citations however, disclose the use of an insert within (or cast within) the concrete, the insert specifically to assist crack propagation when a force is applied externally with or without a groove. This insert further assists the process of crack propagation and is considered to be novel and is an inventive step.

Hence, claims 1-66 are novel and have an inventive step.

all the concrete shrinkage/expansion of the concrete until another crack promoting groove or insert creates a crack. This results in joints with crack promoting grooves or inserts that create cracks early opening wider than those with crack promoting grooves or inserts that create cracks later. Cracked joints that open too wide are undesirable as they typically perform poorly during the life of the concrete path, slab or pavement.

Crack promoting grooves that are formed by concrete saw-cutting are often cut deep in an effort to promote cracking. This is expensive and the deep saw-cut reduces the ability of the cracked joint to transfer shear loads across the joint using aggregate interlock of the cracked concrete on each side of the cracked joint.

10 Summary of the Invention

It is an object of the present invention to provide a method of forming cracks in concrete articles which at least minimises the disadvantages referred to above. It is a further object to provide apparatus for forming cracks in concrete articles

The present invention will be described by way of example with reference to forming cracks in concrete paths, slabs or pavements. It should be appreciated that this description is given by way of example only and that the method of the invention may be used for other purposes also. The method of the invention may be used for allowing concrete articles to be cut into two or more pieces and may also be used for promoting cracks in concrete articles other than paths, slabs or pavements.

According to one aspect of the invention there is provided a method of forming at least one crack in a concrete article having at least one crack promoting insert cast within the concrete article, said method comprising the steps of: -

positioning a tool having a force applying member on or above the surface of the concrete article whereby said member is located adjacent to or above an insert, and causing said tool to apply through said member a force to said concrete article to promote the formation of a crack in said concrete article along said insert.

The force applying member suitably comprises an elongated member.

Where the length of the force applying member is less than the length of an insert, the method of the invention suitably includes the step of progressively moving the tool to different locations longitudinally of the insert and applying a force through the member to the concrete article at each location.

The concrete article is suitably provided with a plurality of crack promoting inserts typically arranged in a grid and the method comprises the step of causing the force

applying member to apply a force or forces to the concrete article to promote the formation of a plurality of cracks in the concrete article along the inserts in the grid.

According to another aspect of the invention there is provided a method of forming at least one crack in a concrete article having at least one crack promoting groove formed in the surface thereof and at least one crack promoting insert cast within
5 the concrete article substantially aligned with said at least one groove, said method including the steps of: -

positioning a tool having a force applying member on or above the surface of the concrete article such that said member is positioned adjacent to or above a groove and
10 insert, and causing said tool to apply through said member a force to said concrete article to promote the formation of a crack in said concrete article along said insert and between said insert and an aligned groove.

The insert is suitably positioned immediately below a groove however the insert may be below and to one side of a groove.

15 Where the length of the member is less than the length of the groove and/or insert, the method of the invention suitably includes the step of progressively moving the tool to different locations along the groove and/or insert and applying a force through the member to the concrete article at each location.

The member may be of a configuration such that it may be received within the
20 groove in which case the step of progressively moving the tool to different locations includes the step of progressively moving the member such that it is located within or may be received within the groove.

Alternatively, the member may be positioned adjacent to or above the groove for application of the force to the concrete article.

25 The concrete article may have a grid of crack promoting grooves formed in an upper surface thereof and a grid of crack promoting inserts cast within the concrete article, respective crack promoting grooves in the grid of grooves being substantially aligned with respective crack promoting inserts of the grid of inserts. The method of the invention in this aspect comprises the step of causing the force applying member to apply
30 a force or forces to the concrete article to promote the formation of a plurality of cracks in the concrete article along the inserts in the grid and between the inserts and substantially aligned grooves.

The force applying member for use in the above methods may comprise an elongated planar contact surface. Alternatively the member may comprise an elongated
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edge or blade-like member such that the member is in the form of a bolster. Where the impact member comprises a planar contact surface, the surface suitably is provided with a strip of rubber or other resilient or cushioning material to accommodate irregularities in the slab surface and protect the concrete surface. Where the member is in the form of a bolster or blade, it may be positioned within the groove or adjacent to a groove.

The concrete article may comprise a concrete path, slab or pavement with reinforcing such as reinforcing fibres, mesh or rods. Alternatively, the concrete article may comprise a concrete path, slab or pavement without reinforcing.

Thus in another aspect, the present invention provides a method of forming at least one crack in a path, pavement or slab cast on a ground surface, said path, pavement or slab having an upper surface and at least one crack promoting insert cast therein, said method comprising the steps of: -

positioning a tool having a force applying member on or above the upper surface of the path, pavement or slab whereby said member is located adjacent to or above said insert, and

causing said tool to apply through said force applying member a force to said path, pavement or slab article to promote the formation of a crack in said path, pavement or slab along a said insert.

Preferably the force applying member comprises an elongated member which preferably has a length less than the length of the insert. Suitably, the method includes the step of progressively moving the member to different locations longitudinally of the insert and applying a force to the path, pavement or slab at each location.

Preferably, the path, pavement or slab has a plurality of crack promoting inserts arranged in a grid and the method suitably includes the step of causing the force applying member to apply a force or forces to the path, pavement or slab to promote the formation of a plurality of cracks in the path, pavement or slab along the inserts in the grid.

At least one crack promoting groove may be formed in the upper surface of the path, pavement or slab in substantial alignment with the at least one insert and suitably the method comprises the steps of positioning the force applying member adjacent to or above the groove and insert, and wherein the step of applying a force to the path, pavement or slab promotes the formation of at least one crack in the path, pavement or slab along an insert and between an insert and an aligned groove.

be removable from the upper surface of the concrete after the concrete hardens or cures or an elongated moulding member cast in the finished surface of the concrete. Alternatively, grooves may be cut in the concrete after the concrete finishing process.

Where the concrete article is provided with an insert or inserts, the insert or
5 inserts in the concrete article may be cast in the article during concrete placement. The insert may have any suitable shape or size. Preferably, the insert is "T" shaped and is placed in an inverted orientation below the groove if used such that the base flange of the "T" sits on the ground or base surface and the leg of the "T" is upstanding. The crack promoting inserts positioned prior to concrete placement provide lines of weakness along
10 which cracks can propagate.

The inserts typically are arranged at right angles to each other and may be formed such that crossing inserts can interlock. For this purpose the leg of a lowermost insert is provided with a slot in its leg to receive the leg of the uppermost insert and the base flange of the uppermost insert is provided with slots to receive the leg of the lowermost
15 insert.

Alternatively or additionally, connectors may be provided to interconnect inserts which extend at right angles to each other. The connectors may include four limbs each extending at right angles to an adjacent limb and restraining means suitably associated with each limb to restrain the base flange of an insert to a limb.

20 In another aspect, the present invention provides apparatus for forming at least one crack in a concrete article provided with at least one crack promoting insert cast therein, said apparatus including a chassis, said chassis supporting tool having a force applying member, and means for causing said tool to apply through said member a force to said concrete article to promote the formation of at least one crack in said concrete
25 article along a crack promoting insert.

In yet another aspect, the present invention provides apparatus for forming at least one crack in a path, pavement or slab cast on a ground surface, said path, pavement or slab having at least one crack promoting insert cast therein, said apparatus including a chassis, said chassis supporting a tool having a force applying member, and means for
30 causing said tool to apply through said member a force to said path, pavement or slab to promote the formation of a crack in said path, pavement or slab along a said crack promoting insert.

The concrete article or path, pavement or slab may additionally be provided with at least one crack promoting groove aligned with the at least one crack promoting insert. Where a plurality of crack promoting inserts are provided in the concrete article or path, pavement or slab, a plurality of crack promoting grooves are suitably aligned with
5 respective crack promoting inserts.

Preferably the chassis comprises a mobile chassis which may be moved to move the tool to different positions on or above the concrete article or path, pavement or slab. The chassis may be supported by at least one pair of steerable wheels to enable the chassis to be steered to different positions on the concrete article or path, pavement or
10 slab. In a particularly preferred form, the chassis may be supported by two pairs of steerable wheels suitably arranged at opposite ends of the chassis. The steerable wheels suitably may be such as to allow the chassis to be moved laterally so that the tool can be repositioned to a side of a previously formed crack in the concrete article or path, pavement or slab. Thus where the concrete article or path, pavement or slab is provided
15 with a grid of crack promoting grooves, the chassis can be moved from a position aligned with one crack promoting groove to a position on one side of the one crack promoting groove for alignment with a further crack promoting groove. Similarly where the concrete article or path, pavement or slab is provided with a grid of crack promoting inserts only, the chassis can be moved from a position aligned with one crack promoting
20 insert to a position on one side of the one crack promoting insert where it is aligned with a further crack promoting insert. The chassis may also be steered to a position from alignment with one crack promoting insert or groove to a position in alignment with an orthogonally extending crack promoting groove or insert.

Preferably the tool comprises an impact tool having a contact member comprising
25 the force applying member for applying a force to the concrete article or path, pavement or slab. The contact member suitably comprises a contact beam and means are provided to apply an impact to the contact beam. The contact beam is suitably supported for movement between a first position where it is elevated above the surface of a concrete article or path, pavement or slab to a second position where it is in contact with the
30 surface of the concrete article or path, pavement or slab. The contact beam suitably extends longitudinally of the chassis. The contact beam is suitably arranged centrally of the chassis however it may be selectively adjusted laterally of the chassis for accurate

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positioning. In an alternative configuration, the contact beam may extend transversely of the chassis for example normal to the longitudinal axis of the chassis.

5 Preferably the chassis supports guides for guiding the contact beam between its first and second positions. The guides suitably guide the contact beam for movement in substantial parallelism. The guides suitably comprise spaced apart guides arranged at opposite ends of the chassis where the contact beam extends longitudinally of the chassis. Suitably elevating and lowering means are associated with each guide for elevating and lowering the contact beam. The elevating and lowering means suitably comprise
10 hydraulic rams.

The means for applying an impact to the contact beam suitably comprises an impact beam, the impact beam suitably comprising a weighted member above the contact beam. Means are suitably provided for elevating the impact beam above the contact beam. Means are also suitably provided for releasing the impact beam from an elevated
15 position to permit it to drop under the influence of gravity towards the contact beam to impact on the contact beam. Suitably the impact beam comprises an elongated beam

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The apparatus 30 may then be moved to further parts of the concrete slab 10 in the manner described above to create the further cracks 11 where desired.

The contact member 47 may have a planar undersurface 48 as described or may be in the form of a bolster or blade 29 as for example of the configuration shown in Fig.

5 2.

In an alternative arrangement shown in Fig. 16, the member 48 may comprise a combination of the planar surface 48 and a strip 49 of rubber or other resilient material of a width less than the width of the surface 48 and located centrally of the planar surface 48.

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Fig. 17 illustrates an alternative apparatus 74 for use in the method of the invention, the apparatus 74 being similar in configuration to the apparatus of Figs. 13 and 14 and having a contact beam 42 with a contact member 47 for contact with the concrete surface and a support chassis and steering arrangement similar to the apparatus 30. As above, hydraulic rams or actuators 45 as before are provided for elevating or lowering the contact beam 42. In this case however a vibratory force is generated by a mechanical (or fluid actuated) vibrator 75 which is mounted on the top side of the contact beam 42. Thus when the contact beam 42 is lowered so that the contact member 47 contacts the concrete surface 25 as in Fig. 17, the vibrator 75 is actuated to cause a vibratory force to be applied to the surface 25 through the member 47 to cause the propagation of a crack 11 in the concrete slab 10 along an insert 12 and groove 28 in the slab surface 25.

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Fig. 18 illustrates typical movements of the impact applying apparatus 30 (or 74) over a slab 10 for formation of the grid of cracks 11. The apparatus 30 in this case has front and rear wheels 32 and 33 which can be pivoted at least 180 degrees. This permits the apparatus 30 to be driven forwardly from the position X in Fig. 18 to the position Y for formation of a first line of cracks 11 across the slab 10 in which case the wheels 22 and 23 are aligned with the longitudinal axis of the apparatus. At the position Y, the wheels 32 and 33 are pivoted 90 degrees which enables the apparatus 30 to be driven laterally to the position Z where the wheels 32 and 33 can be again pivoted back through 90 degrees for formation of the second line of cracks 11. The apparatus 30 can then be continued to be moved over the slab 10 for formation of the grid of cracks 11.

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For faster more accurate alignment of the apparatus 30 above the crack promoting groove 28 and/or insert 12 and thereby more accurate creation of the cracks 11 within the slab, a laser guidance system 76 shown in Fig. 19 may be used to guide movement of the

30. A method as claimed in any one of claims 1 to 28 wherein said inserts are arranged at right angles to each other and including connectors for interconnecting said inserts.

5 31. A method as claimed in any one of the preceding claims wherein said force applying member comprises an elongated member having a planar force applying face, said member including a strip of cushioning material on said face.

10 32. A method of forming at least one crack in a path, pavement or slab cast on a ground surface, said path, pavement or slab having an upper surface and at least one crack promoting insert cast therein, said method comprising the steps of: -

positioning a tool having a force applying member on or above the upper surface of the path, pavement or slab whereby said member is located adjacent to or above said insert, and

15 causing said tool to apply through said force applying member a force to said path, pavement or slab to promote the formation of a crack in said path, pavement or slab along a said insert.

20 33. A method as claimed in claim 32 wherein said force applying member comprises an elongated member and wherein the length of said member is less than the length of said insert and wherein said method includes the step of progressively moving the member to different locations longitudinally of the insert and applying a force to the path, pavement or slab at each location.

25 34. A method as claimed in claim 32 or 33 wherein said path, pavement or slab has a plurality of crack promoting inserts arranged in a grid and wherein said method includes the step of causing the force applying member to apply a force or forces to the path, pavement or slab to promote the formation of a plurality of cracks in the path, pavement or slab along the inserts in the grid.

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35. A method as claimed in any one of claims 32 to 34 wherein at least one crack promoting groove is formed in the upper surface of said path, pavement or slab in substantial alignment with said at least one insert and wherein said method comprises the

60. Apparatus according to claim 59 wherein said laser guidance system includes means for establishing a laser plane offset from and parallel to a row of inserts and laser receivers on the apparatus aligned with a longitudinal axis of said apparatus.

5 61. Apparatus for forming at least one crack in a path, pavement or slab cast on a ground surface, said path, pavement or slab having at least one crack promoting insert cast therein, said apparatus including a chassis, said chassis supporting a tool having a force applying member, and means for causing said tool to apply through said member a force to said path, pavement or slab to promote the formation of a crack in said path,
10 pavement or slab along a said crack promoting insert.

62. Apparatus as claimed in claim 62 wherein said chassis comprises a mobile chassis whereby said apparatus may be moved to different positions on the path, pavement of slab, said chassis supporting wheels which are steerable to permit said chassis to be
15 moved laterally for repositioning said tool.

63. Apparatus as claimed in claim 61 or 62 wherein said tool comprises an elongated contact beam comprising the force applying member, means for supporting said contact beam for movement between a first position where it is elevated above the upper surface
20 of the path, pavement or slab and a second position where it is in contact with the surface of the path, pavement or slab, and means for applying a force to the contact beam.

64. Apparatus as claimed in claim 63 wherein said tool comprises an impact tool and wherein said means for applying a force to said contact beam comprises a weighted
25 member comprising an impact beam above said contact beam for applying an impact to said contact beam.

65. Apparatus as claimed in claim 64 and including means for elevating said impact beam above said contact beam and means for releasing said impact beam to permit said
30 impact beam to drop under the influence of gravity towards said contact beam.

66. Apparatus as claimed in any one of claims 63 to 65 wherein said contact beam includes a contact member having a planar surface for contact with said path, pavement or slab.